New Low-Gravity Research Aircraft Takes to the Skies

Lewis' DC-9 aircraft beginning a parabolic trajectory.

A new research aircraft began operations at the NASA Lewis Research Center this past year. The aircraft, a McDonnell Douglas Corporation DC-9, began providing researchers funded by NASA Headquarter's Microgravity Science and Applications Division additional opportunities to perform research in a weightless environment, similar to that in orbiting spacecraft.

During a single flight, the aircraft can provide investigators with approximately 40 periods of weightlessness, with each period lasting approximately 22 sec. To provide weightlessness, the pilots fly a special maneuver known as a Keplarian, or parabolic, trajectory. First, the aircraft is put into a shallow dive to increase airspeed. Once at the desired airspeed, the pilots begin to climb, at up to a 60° angle. Once the airspeed drops to the desired level, the pilots "push over," putting the aircraft and its occupants in a free-fall, or weightless, condition. As the aircraft is pushed over, it begins to dive as the weightless condition continues. When the aircraft reaches a 40° downward angle, the pilots return the aircraft to level flight or begin the next parabola, ending the weightless period. During the entry and exit portions of the trajectory, the aircraft and its occupants experience a force of up to twice that of normal Earth gravity (up to 2g).

When Lewis acquired the DC-9, it was configured as a standard passenger aircraft. Lewis and support service contract engineers and technicians spent over a year modifying the aircraft for its new role as an airborne laboratory. All the work was completed at Lewis, with exception of the installation of a cargo door to facilitate the installation and removal of experiments, which was completed under contract. The aircraft is now configured to support up to 8 experiments and 20 experimenters per flight.

Research area inside Lewis' DC-9.

Modifications and installations completed at Lewis included a new power system, which was designed and installed to provide the experiments with electrical power. The interior was completely removed, and a new interior was installed to provide a large, unobstructed area for research operation. The cabin interior was then padded to protect the experimenters from being injured while floating about the cabin. The lighting in the cabin was modified to provide adequate light for research while minimizing electrical noise output, which might interfere with experiments. An acceleration measurement and display system was also installed to help the pilots achieve and maintain a low-gravity environment. Numerous other systems were installed to support research, including an overboard vent, an intercom system, and a video and data recording system.

The DC-9 was completed and began supporting research investigations in combustion, fluid physics, and materials science in mid-May. This aircraft is also used by researchers from other NASA centers, other Government agencies, universities, and international agencies such as the Canadian Space Agency. The DC-9 aircraft will be a valuable research tool for years to come because it provides a low-cost opportunity for researchers to perform basic research and test systems on Earth that are destined for space.